Analysis of laser speckle contrast images variability using a novel empirical mode decomposition: comparison of results with laser Doppler flowmetry signals variability.

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Résumé en anglais	Laser Doppler flowmetry (LDF) and laser speckle contrast imaging (LSCI) have emerged as non invasive optical modalities to monitor microvascular blood flow. Many studies proposed to extract physiological information from LDF by analyzing signals variability. By opposition, such analyses for LSCI data have not been conducted yet. We propose to analyze LSCI variability using a novel data-driven method: the complete ensemble empirical mode decomposition with adaptive noise (CEEMDAN). CEEMDAN is suitable for non linear and non stationary data and leads to intrinsic mode functions (IMFs). It is based on the ensemble empirical mode decomposition (EEMD) which relies on empirical mode decomposition (EMD). In our work the average frequencies of LSCI IMFs given by CEEMDAN are compared with the ones given by EMD and EEMD. Moreover, LDF signals acquired simultaneously to LSCI data are also processed with CEEMDAN, EMD and EEMD. We show that the average frequencies of IMFs given by CEEMDAN depend on the signal to noise ratio (SNR) used in the computation but, for a given SNR, the average frequencies found for LSCI are close to the ones obtained for LDF. By opposition, EEMD leads to IMFs with frequencies that do not vary much when the SNR level is higher than a threshold. The new CEEMDAN algorithm has the advantage of achieving a complete decomposition with no error in the reconstruction but our study suggests that further work is needed to gain knowledge in the adjustment of the added noise level. CEEMDAN, EMD and EEMD are data-driven methods that can provide a better knowledge of LSCI.
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